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## (54) HANDRAIL GUIDE SYSTEM FOR PASSENGER CONVEYOR


(71) We, WESTINGHOUSE ELECTRIC CORPORATION, of 3 Gateway Center, Pittsburgh, Pennsylvania, United States of America, a Company organised and existing under the laws of the Commonwealth of Pennsylvania, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—


This invention relates to passenger conveyors such as moving stairways or moving walks, and has particular relation to such conveyors having moving handrails operating in synchronism with said conveyor.

It is common practice and a Safety Code Requirement in such apparatus to provide at each side of the conveyor a continuous or endless flexible handrail in the form of an elongated loop having an upper run to be grasped by conveyor passengers. The loop also has a lower or return run and its upper and lower runs are interconnected by curved end portions.

Conventionally the handrail is constructed with a C-shaped cross-section and is supported on its upper run by a generally T-shaped stationary guide fastened to the upper surface of the balustrade. Other constructions are utilized or have been proposed but this is the most widely used form. Large newel wheels serve as guides for the curved end portions as shown in Reissue U.S. Patent No. 2,885,057. Usually at least one of these newel wheels is connected to the conveyor whereby the handrail is driven in synchronism with the conveyor. The lower or return run of the handrail is usually supported at various points by guide wheels in accordance with a number of schemes.

According to the prior art, it has consistently been the practice to apply tension to the handrail primarily to obtain the tractive force necessary to pull the handrail around the guide loop and to eliminate the need for a continuous guide on the lower return run. Normally the tension has been applied by apparatus providing a looped part in the lower return run. Since the handrail is usually made of an elastomer such as rubber, the handrail tends to stretch under tension despite the reinforcing materials such as cotton fabric or canvas embedded in the rubber. Often steel reinforcement such as high tensile wires or steel strip is molded into the handrail to prevent stretch. The tensioning of the handrail causes excessive wear on the handrail as it moves over the stationary guide and makes it imperative that a moving guide be provided in the end portions where the handrail must negotiate curves of relatively small radii. This problem was fully appreciated when it became fashionable to provide transparent balustrades and the newel wheels were eliminated. It was found that even with numerous small wheels distributed around the curved end portions as in the U.S. Patent No. 3,049,213, excessively high driving forces were required and the excessive wear on the handrail was unacceptable. In addition the utilization of numerous small guide wheels raises the cost of the handrail system considerably and requires frequent maintenance to clean the wheels of debris to insure free turning.

It is the principal object of the invention to provide a passenger conveyor system having handrail guide means which can be readily adjusted to compensate for variations in the length of handrails, and which at the same time allow a handrail to be driven in a manner reducing the tensile loading on any given section thereof.

The invention accordingly resides in a passenger conveyor comprising a supporting structure, a continuous load bearing conveyor mounted on said supporting structure, a vertical balustrade mounted on the supporting structure adjacent the conveyor and extending a substantial distance therealong, a handrail guide member extending along the upper surface of the balustrade, downward near the ends thereof, and along the supporting structure underneath the balustrade so as to form a substantially closed guide loop, a handrail comprising an endless flexible belt supported and guided by the guide member for

Above the conveyor 1 is a balustrade 8 for supporting a handrail 9. Usually a handrail is provided for each side of the conveyor. By referring to Figure 2 it can be seen that the handrail 9 is C-shaped in cross-section with a base portion 9*a* and legs 9*b* each with a lip 9*c*. The handrail 9 is in the form of a closed loop and is mounted with the opening of the C disposed towards the center of the loop whereby the base 9*a* of the handrail is available to be grasped by passengers on the stairway.

The handrail 9 is guided in its closed loop by the continuous guide member 11. The guide member has an upper portion 11*a* which extends along the upper surface of the balustrade, a lower section 11*b*, two end sections 11*c* and *d* and a flexible section 11*g*. Portions of the handrail 9 have been removed in Figure 1 to expose various portions of the guide member 11. The guide member 11 forms a continuous guide for the handrail 9 except for the section between 11*e* and 11*f* where the handrail passes through a driving mechanism comprising rollers 53 and 57 and except for the small gap 11*h* which will be described in more detail below.

The guide member 11 may be of the conventional T-shape or Y-shape commonly in use today. Alternatively the guide member may be U-shaped as shown in cross-section in Figure 2 with vertical legs 13 ending in horizontal flanges 15. Such a U-shaped guide member can be extruded from aluminum, stainless steel or practically any metal or non-metallic material which can be easily bent to follow the contours of the balustrade. Guide member 11 is secured to the balustrade 8 at various points along its length by bolts 17 secured by nuts 19.

It can be seen from Figure 2 that the lips 9*c* of the handrail 9 fit over the flanges 15 of the guide member 11 to restrain the handrail to the path formed by the guide member. As was mentioned above the loading on the handrail is such that satisfactory wearing is experienced with the handrail 9 running in direct contact with the flanges 15 of the guide member 11. However, even longer wear may be realized by placing strips of material having low friction characteristics over the flanges 15. A U-shaped nylon strip such as strip 21 shown in Figure 2 has been found to be satisfactory for this purpose. By extending one leg of the U-shaped nylon strip 21 and forming a lip 22 on the end of this extended leg, the nylon strip may be snapped into place over the flange 15 as shown in Figure 2.

In order to provide that the overall length of the guide loop formed by the guide member may be adjusted to the exact length of the handrail 9, a portion of the guide member is made flexible as indicated at 11*g* in Figure 1. The adjustment is provided by constructing a portion of the guide member of a flexible yet stiff material. This portion of the guide member is rigidly connected to the supporting structure 23 below the balustrade 8 at a point 23*a*. The other end of this flexible portion of the guide member is connected to the supporting structure at a variable point 23*b*. A cross-section of the flexible portion of the guide member 11 is shown in Figure 4. Projecting from the base 25 are two short legs 27 which are surmounted by horizontal flanges 29. The shallow depth of this portion of the guide member permits it to be bowed easily. It should be made of material which will flex easily but will maintain its bowed shape against the moderate forces exerted by the handrail tending to collapse the bowed portion. Polyvinyl has been found to be suitable for this purpose and a light gauge metal guide such as extruded aluminum has been found to be even more satisfactory since it will dissipate the heat generated by friction more readily especially on long runs.

The movable end of the flexible portion of the guide member 11*g* is connected to the supporting structure 23 by bolts 31 passing through the slot 37 in the supporting member and secured by nuts 33 as can be seen from Figures 3 and 4. A sleeve 35 spaces the guide member 11*g* from the supporting structure 23 so that the lips 9*c* of the handrail clear the supporting structure. It can be seen from Figure 3 that the amount of bow in the flexible section 11*g* can be varied by varying the position of the bolts 31 with respect to the slot 37. In order to bow the flexible portion 11*g* of the guide member, the bolts 31 are moved to the right in Figure 3 with respect to the slot 37. This will increase the total length of the guide loop. The extra length comes from a gap 11*h* between the ends of the flexible portion 11*g* and the fixed portion of the return run of the guide member. This gap in the guide loop is normally not large enough to interfere with the operation of the guide rail system since the handrail itself has a certain amount of stiffness. It should be appreciated that the amount of bow shown in Fig. 1 has been exaggerated for purposes of illustration. The center of this bowed section can be supported by a brace connected to the supporting structure although this has been found to be unnecessary. Also more than one bowed section can be used if needed.

With a substantially continuous guide loop adjusted to the length of the handrail so that static tension is not required to maintain the handrail in the guide loop, the handrail can be pushed as well as pulled around the closed loop through the utilization of much lower forces at any particular

claim 1 or 2, wherein the flexible portion of said guide member has the opposite ends thereof fastened to said supporting structure, at least one end of said flexible portion being adjustable relative to the other end thereof in the longitudinal direction of the guide member.

4. A passenger conveyor according to claim 3, wherein said flexible portion has the ends thereof fastened to said supporting structure by adjustable mounting means including a plate having a slot oriented parallel to the longitudinal axis of said guide member, and fastening means connected to said flexible portion of the guide member and passing through said slot so as to clamp said flexible portion to said plate, said fastening means being slidable in said slot to adjust the position of said flexible portion of the guide member with respect to the plate.

5. A passenger conveyor according to any of the preceding claims wherein said endless flexible belt has a generally C-shaped cross-section with the opening of the C oriented toward the center of the guide loop, and said guide member has flange portions thereof captively engaged with the C-shaped belt and constraining the latter to its guided path.

6. A passenger conveyor according to claim 5, wherein said guide member has U-shaped strips of low-friction material clamped over said flange portions thereof.

7. A passenger conveyor substantially as hereinbefore described with reference to, and as illustrated in, the accompanying drawings.

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